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(54) **Coating apparatus**

(57) A fluid application system for applying fluid to a moveable surface comprises an applicator roller (3) moveable between a position in which it contacts the surface and a position in which it is spaced from the surface. A means (7, 8, 9, 10 and 11) is provided to rotate the applicator roller when it is in contact with the surface and a means (12, 15, 16, 17, 10 and 11) is provided to rotate the applicator roller when it is spaced from the surface. The system may form part of a fluid applying machine which can operate in one mode as a printing machine or in another mode as a coating machine.

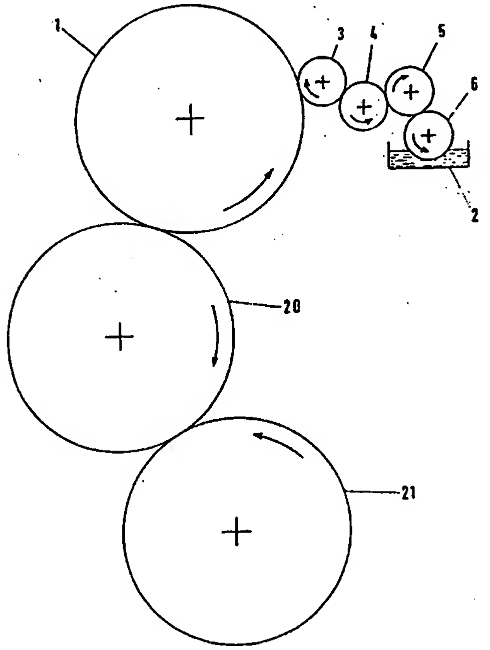

FIG. 1

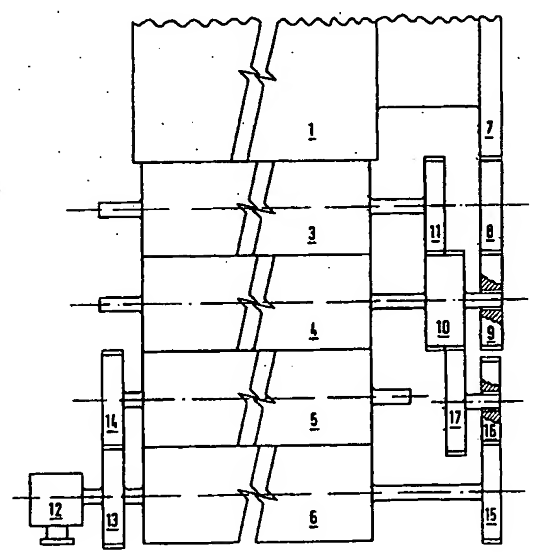

FIG. 2

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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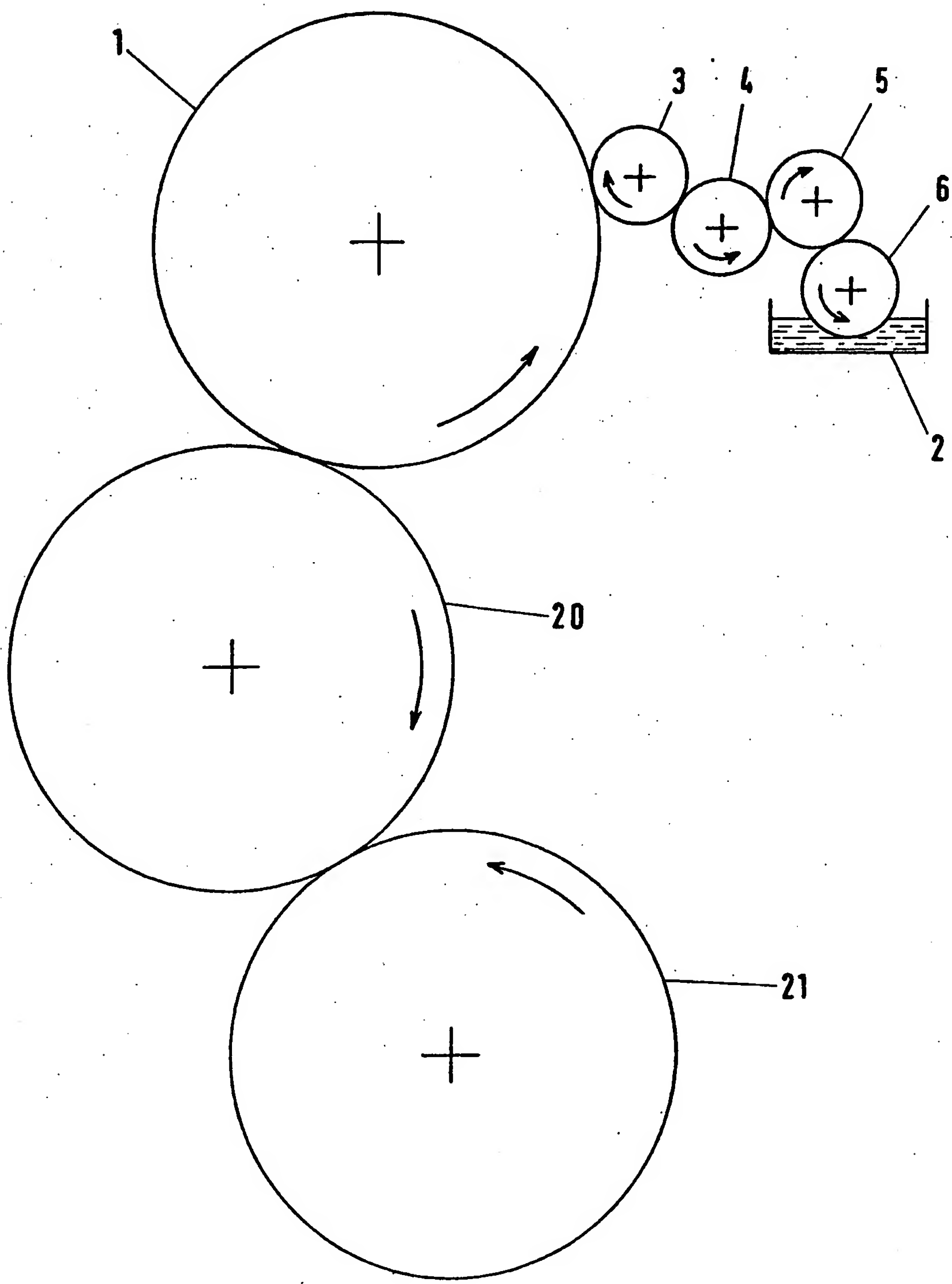

FIG. 1

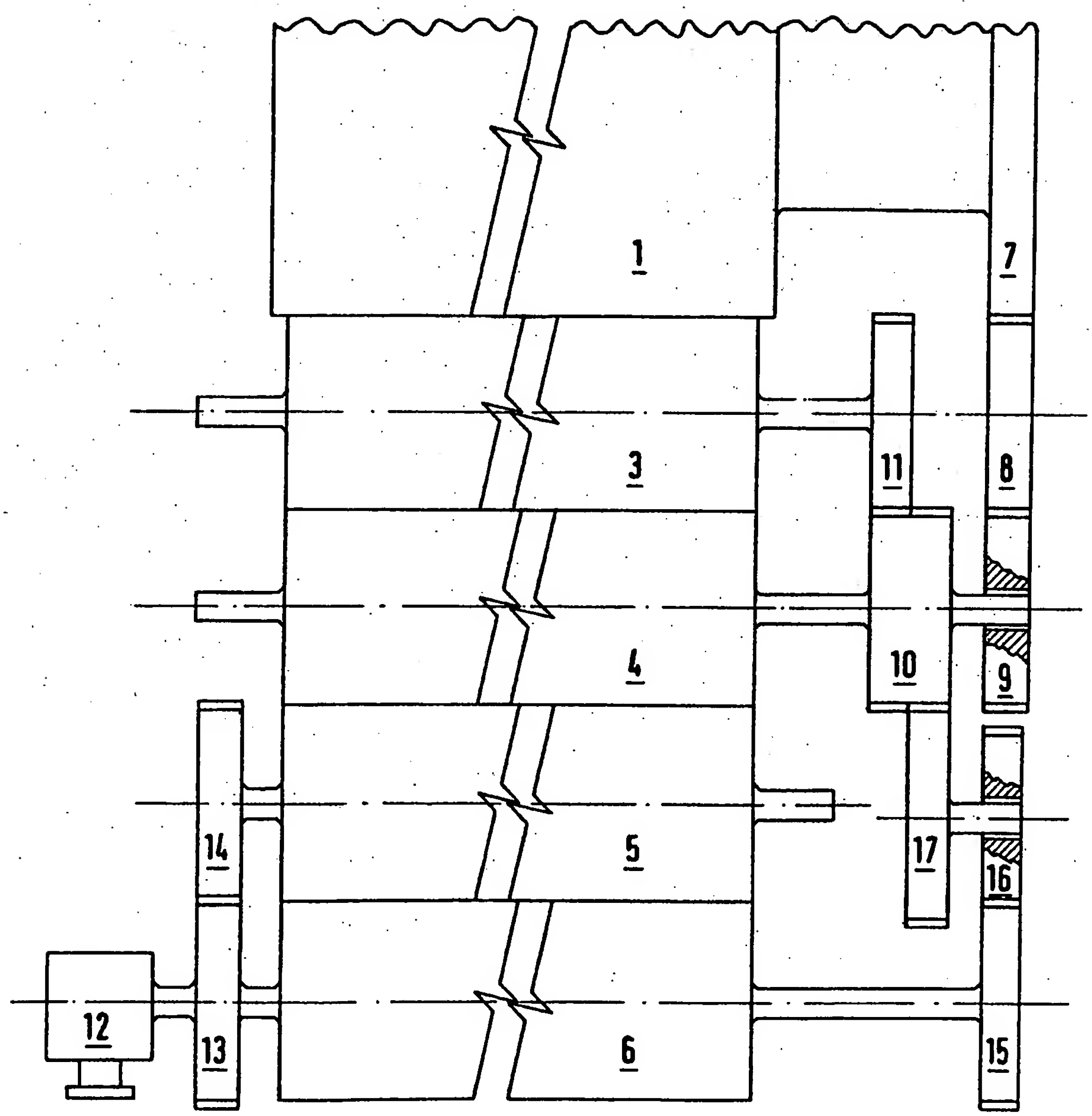

FIG. 2

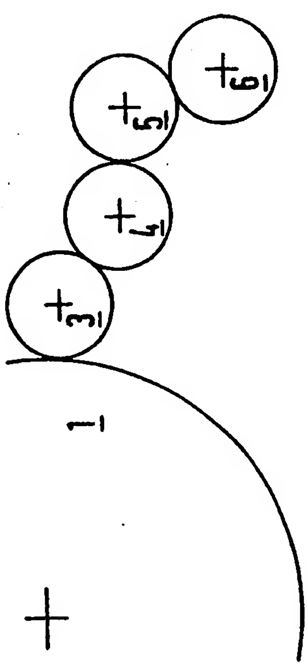

FIG. 3

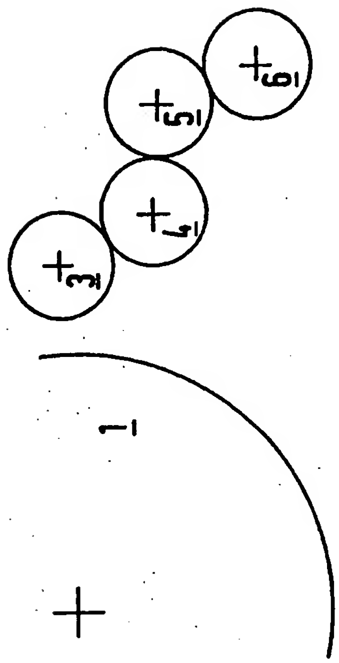

FIG. 4

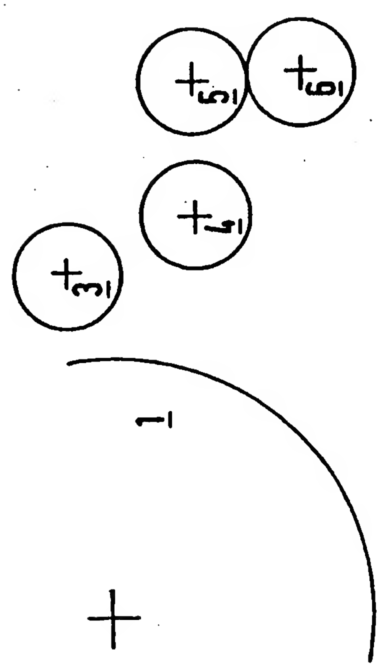

FIG. 5

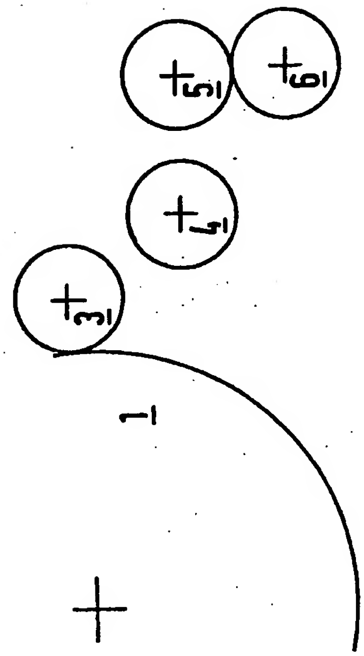

FIG. 6

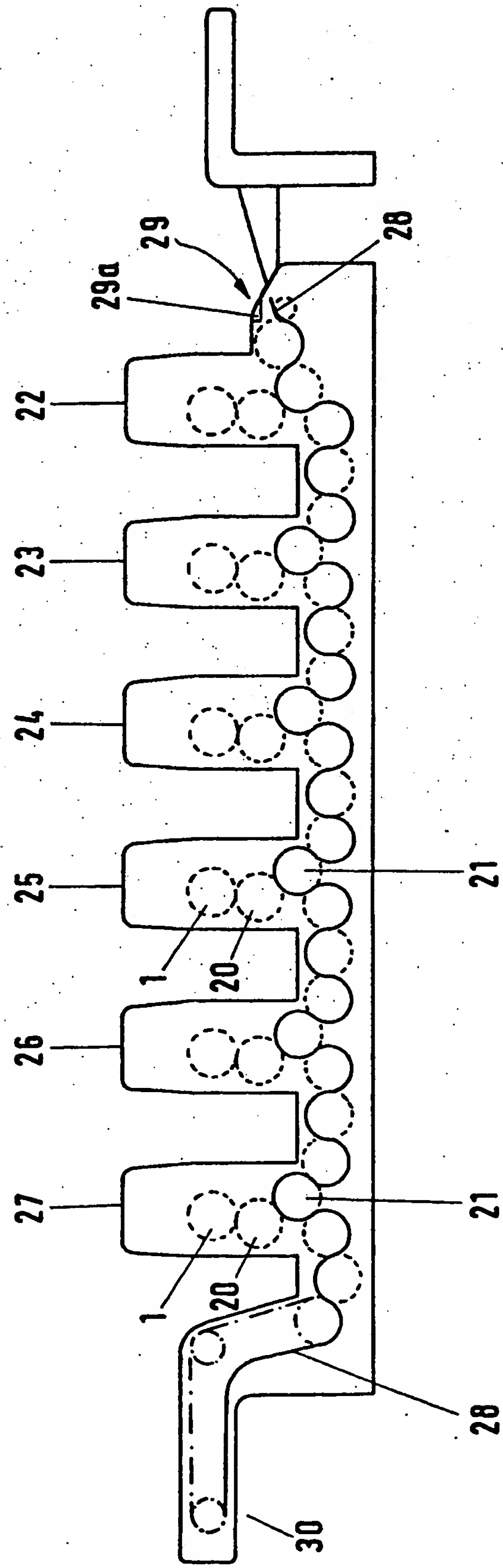

FIG. 7

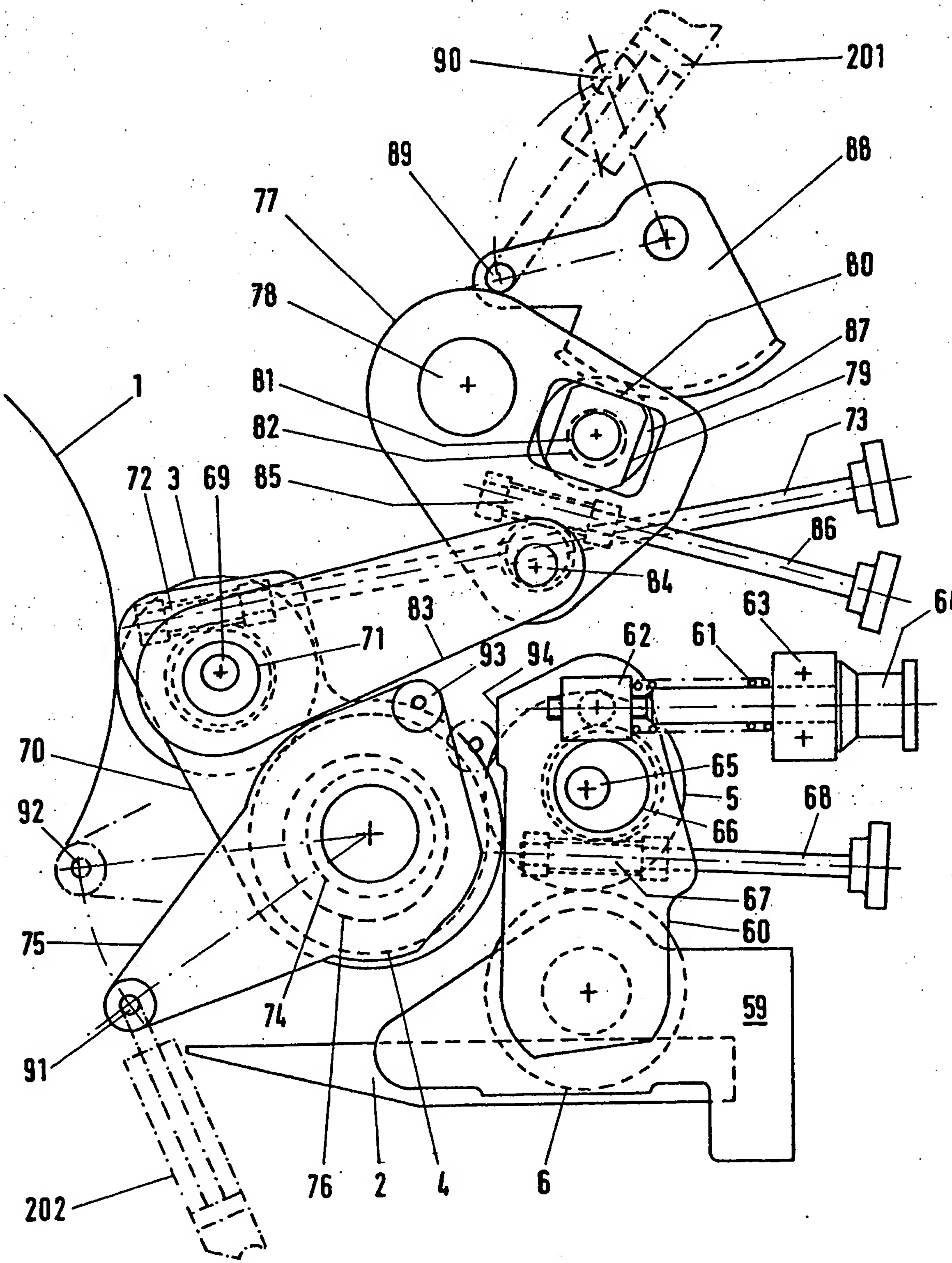
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FIG. 8

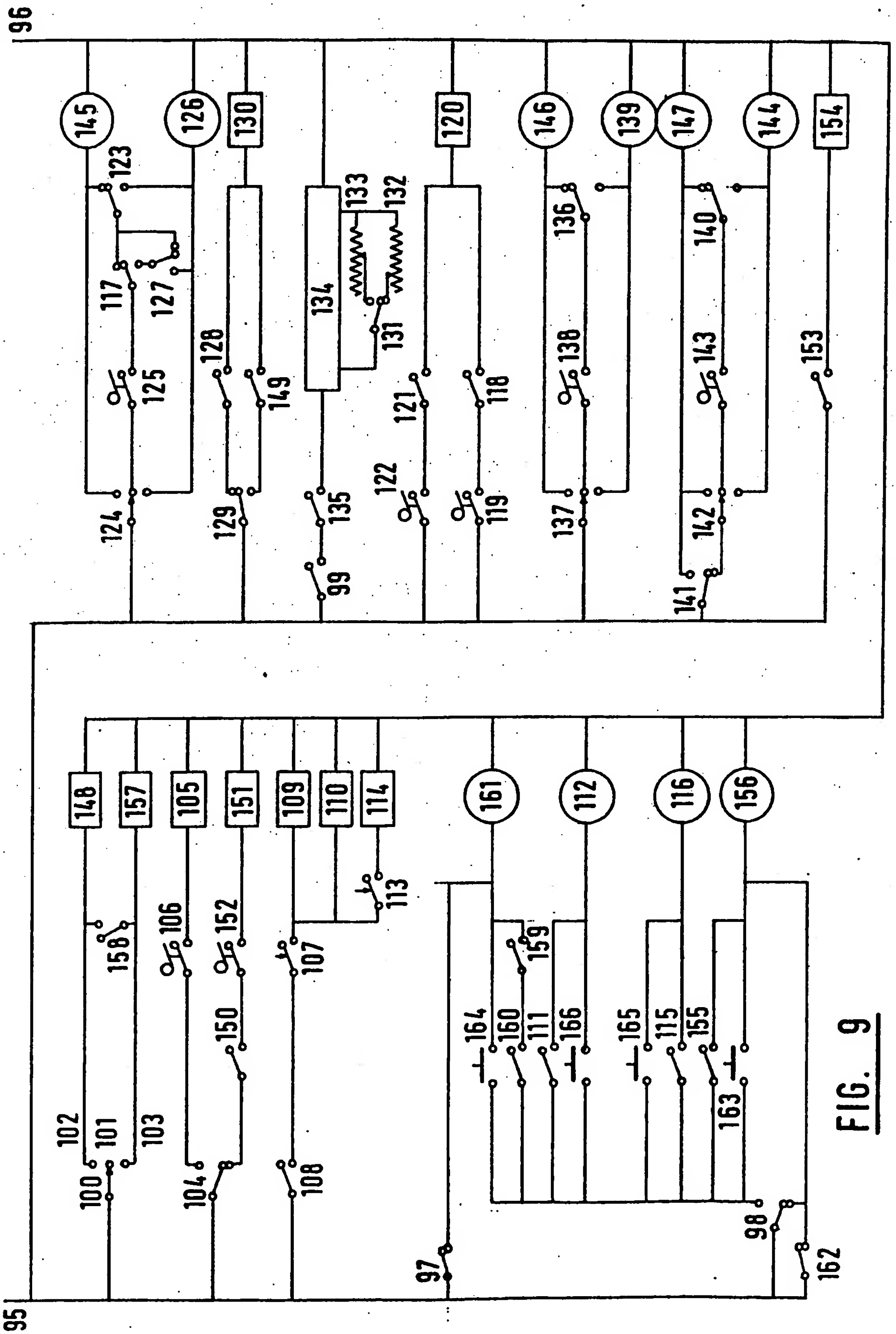
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FIG. 9

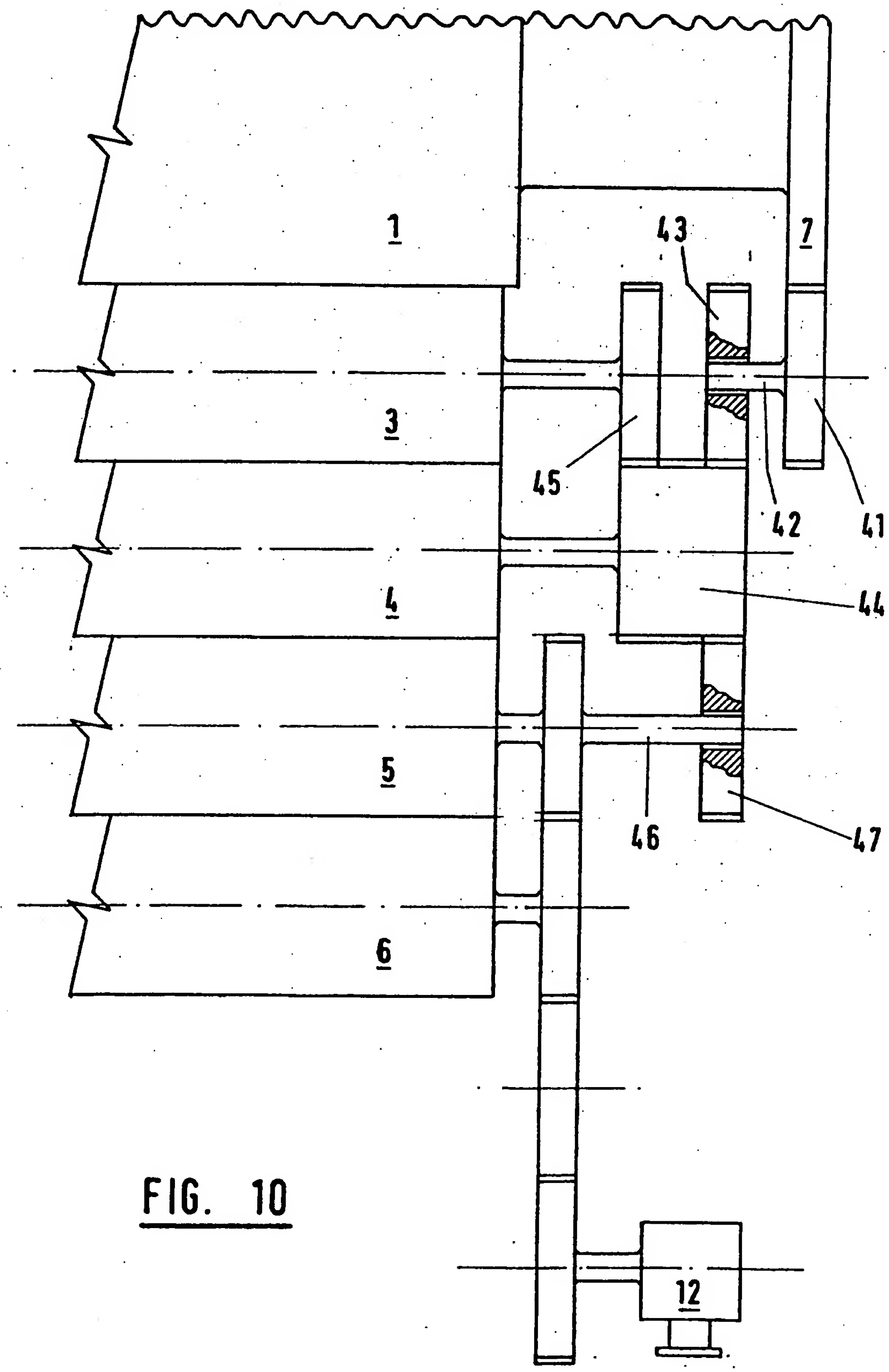

FIG. 10

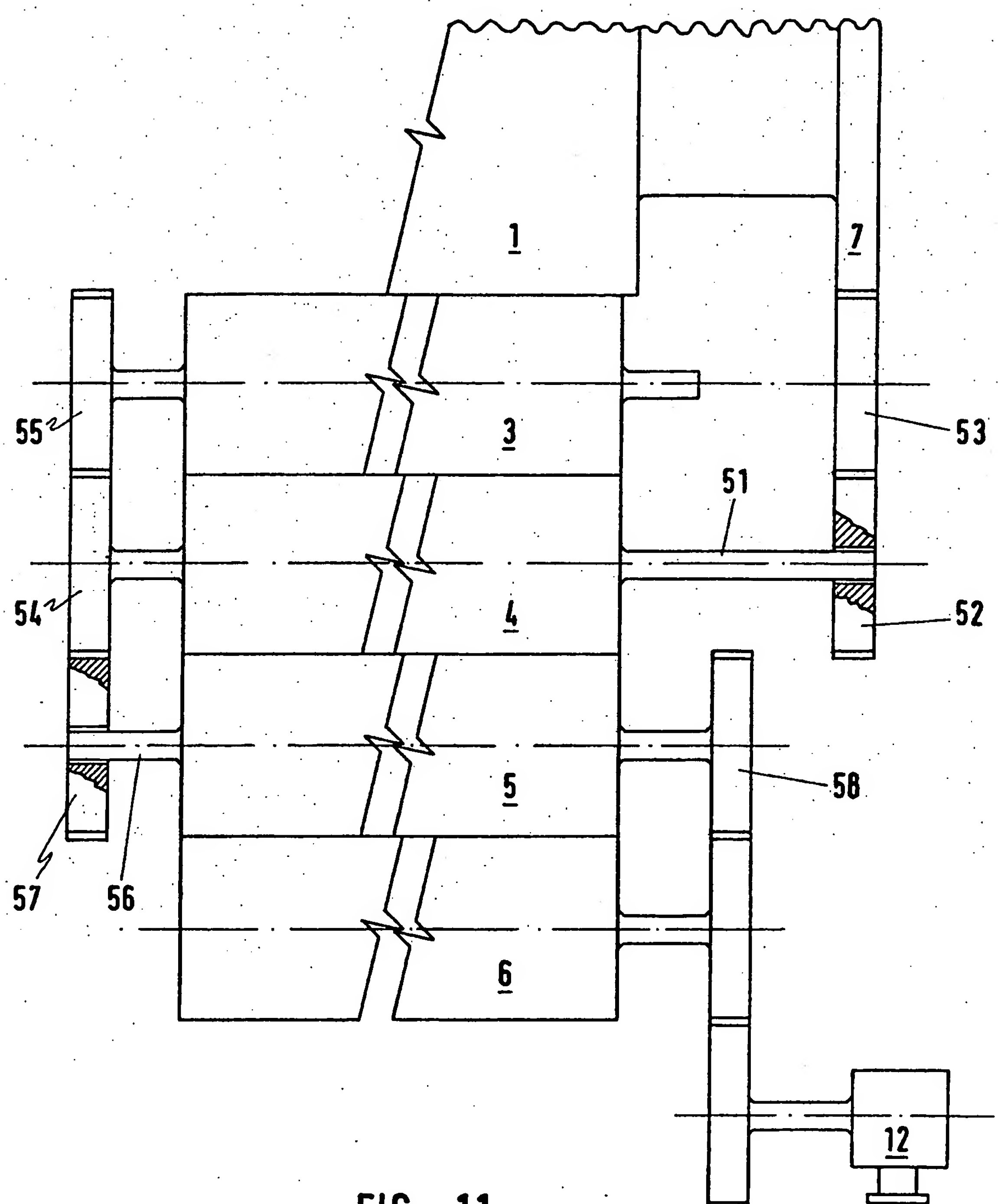

FIG. 11

SPECIFICATION

Improvements in or relating to the application of fluids

This invention relates to fluid applying machines and is concerned with such machines wherein an accurately and consistently metered film of fluid is applied to a moving surface.

The invention is applicable to lithographic printing machines, in which case the fluid may be a damping solution and the fluid receiving surface may be the surface of a lithographic printing plate, or the fluid may be a coating fluid for coating onto material passing through the printing press, for decorative or protective purposes. The invention is, however, also applicable to coating machines in which case the fluid is a coating fluid for coating on to, for example, printed material for decorative or protective purposes. The coating fluid may be applied to the printed material or the like indirectly in which case the fluid receiving surface may be the surface of (i) a plate mounted on a printing machine plate cylinder, (ii) a rubber blanket which may have a continuous surface or which may be relieved or underpacked to vary the effective thickness in certain areas so as to transfer fluid selectively, or (iii) a transfer roller which may have a continuous surface or which may have a surface relieved in certain areas so as to transfer fluid selectively. Alternatively, the coating fluid may be directly applied to the printed material or the like in which case the fluid receiving surface is the surface of the material itself.

During lithographic printing, damping solution is applied to the printing plate in the form of a very thin film and the solution is principally water in which isopropyl alcohol, gum arabic, and other additives may be dissolved. Coating fluids may include a solvent based coating medium or may include a coating medium in the form of an emulsion in a fluid carrier, often water. As the solvent or carrier evaporates a film of coating medium remains on the paper, board or other material being coated. The rate of evaporation of lithographic damping solution or of coating medium solvent or carrier is necessarily quite rapid, and it is an object of the invention to provide a fluid application system for a fluid applying machine wherein drying off of the fluid application system is prevented or inhibited whilst the machine is stopped or idling without material or the like being passed through it for printing or coating, or to provide means to refresh and renew the film of fluid on the roller system whilst the machine is stopped or idling in preparation for a flow of material to be printed or coated to commence.

It is a further object to provide a fluid applying machine in the form of a lithographic printing machine wherein the system for applying damping solution during printing can be used alternatively for applying coating fluid.

According to one aspect of the present invention there is provided a fluid application system for applying fluid to a moveable fluid receiving surface, which system comprises:

(i) an applicator roller moveable between a position in which it contacts said surface, and a position in which it is spaced from said surface,

(ii) a source of fluid,

(iii) a means of transferring fluid from said source to said applicator roller,

(iv) a means of rotating the applicator roller at the same surface speed as the surface when it is in its position where it contacts said surface, and

(v) a means of rotating the applicator roller when it is in its position where it is spaced from said surface irrespective of whether or not the surface is moving.

In a particularly preferred embodiment the means of transferring fluid from said source to said applicator roller comprises a rotatably mounted second roller arranged to form a nip with the applicator roller both when it is in contact with the surface and when it is spaced from the surface and a metering roller mounted for rotation so as to form a nip with said second roller and arranged to receive fluid from said source. The second roller and the applicator roller are geared together so that they rotate at the same surface speed and a first drive means is provided to move the fluid receiving surface. A first transmission system links the first drive means and the second roller so that the applicator roller has the same surface speed as the fluid-receiving surface when in its position where it contacts the surface. A second drive means is provided for rotating the metering roller independently of the fluid receiving surface and a second transmission system links the second drive means and the second roller so that the applicator roller can also be driven by the second drive means. The first and second transmission systems are so arranged that, in normal operation of the fluid application system with the applicator roller in its position where it contacts the surface, the applicator roller is driven from the first drive means and the second transmission system is over-ridden. When the applicator roller is tripped to its position where it is spaced from the surface and the first drive means is stopped or rotating very slowly, the applicator roller is driven from the second drive means and the first transmission system is over-ridden.

By enabling the applicator roller to be kept rotating in this way irrespective of whether or not the fluid receiving surface is rotating, the applicator roller and the fluid transferring means are kept wetted with the fluid and thus drying off is prevented.

Preferably the source is in the form of a trough containing the fluid and the transferring means includes a fourth roller dipping into the fluid in the trough and mounted for rotation so as to form a nip with the metering roller and geared to the metering roller so as to rotate with the metering roller.

In the case where the system includes an applicator roller and three other rollers in, for example, the manner described above, it is preferred for these four rollers to be arranged so that they can adopt various configurations in accordance with a further aspect of the present invention which provides a fluid application system for applying fluid to a moveable fluid-receiving surface, which system comprises,

(i) an applicator roller,

(ii) a source of fluid, and

(iii) a means of transferring fluid from said source to said applicator roller, which transferring means comprises second, third and fourth rollers, wherein said rollers can adopt

(a) a first configuration in which the applicator roller is in a first position in which it contacts said surface and said second roller and the third roller is in a first position in which it contacts the second roller and the fourth roller,

(b) a second configuration in which the applicator roller is in a second position in which it is spaced from said surface but contacts said second roller and said third roller is in its first position,

(c) a third configuration in which the applicator roller is in a third position in which it is spaced from said surface and from said second roller and said third roller is in a second position in which it is spaced from the second roller but contacts the fourth roller, and

(d) a fourth configuration in which the applicator roller is in a fourth position in which it contacts said surface but is spaced from second roller and said third roller is in its second position.

The fluid application systems in accordance with the foregoing aspects of the present invention may be used in a fluid applying machine in accordance with another aspect of the present invention for applying fluid to material which machine comprises,

(i) a moveable fluid-receiving surface,

(ii) a fluid application system comprising an applicator roller, a source of fluid, and a means of transferring fluid from said source to said applicator roller, said applicator roller being moveable between a position in which it contacts said surface and a position in which it is spaced from said surface,

(iii) a means for controlling the amount of fluid transferred from said source of fluid to said applicator roller,

(iv) a means of transporting material through the machine along a path to a station at which it can receive fluid from said fluid receiving surface,

(v) a means of detecting the presence or absence of material at a location along said path,

(vi) a mechanism actuable in dependence on the detecting means and operable in

(a) a firstmode in which it regulates the fluid controlling means such that the amount of fluid transferred to said applicator roller is adjusted in dependence upon whether or not material is present at said station, and

(b) a second mode in which it moves the applicator roller between its positions and regulates the fluid controlling means such that the applicator roller is moved to its position in which it is spaced from said surface and the amount of fluid transferred to it is adjusted at a selectable time interval before no further material is present at said station and the applicator roller is moved to its position in which it contacts said surface and the amount of fluid transferred to it is adjusted at a selectable time interval before further material is present at said station, and

(vii) a selector switch operably connected to said detecting means for enabling the mechanism to operate in either the first mode or the second mode as desired.

In accordance with this aspect of the invention the behaviour of the machine when no material is detected at said location can be selected by suitably actuating the selector switch.

In the case where the machine is to operate as an offset lithographic printing machine, the selector switch is actuated by the operator so that the first mode of operation occurs. In this way, when no material is detected at said location, the mechanism automatically operates so that, at the time the missing material would have reached the printing station, the amount of fluid (i.e. damping solution) being transferred from the fluid source to the applicator roller is adjusted, contact is broken between the plate cylinder and the blanket cylinder, and the blanket cylinder and the impression cylinder no longer co-operate. In the case where the flow of material through the machine is halted temporarily, the applicator roller remains in its position where it is in contact with the fluid receiving surface. However, in the case where the flow of material is halted for a relatively long time, it is preferred for the applicator roller to be tripped to its position in which it is spaced from the fluid receiving surface. This can be effected manually (possibly remotely controlled) or automatically by means of a timer. The adjustment in fluid transfer and possibly tripping of the applicator roller are arranged to take place at a time such that material still in train in the machine is properly printed at the printing station. When the flow of material is recommenced, the applicator roller is tripped back into contact with the fluid receiving surface as necessary and the fluid transfer is readjusted at a time corresponding to a number of machine revolutions before the material reaches the printing station. If desired, this number may be controllable by the operator. Also the cylinder contacts are automatically re-established in sequence so that the first material to arrive at the printing station is properly printinted.

In the case where the machine is to operate as a coating machine, the selector switch is actuated by the operator so that the mechanism operates in the second mode. In this way, at a time interval (selectable by the operator) after no material is detected at said location the mechanism initiates a trip-off sequence wherein the applicator roller automatically moves to its position in which it is spaced from the fluid receiving surface, until such time as the flow of material recommences, and the amount of fluid transferred to the applicator roller is adjusted. When the last material in train in the machine has passed the coating station, the contact between the blanket and plate cylinders is automatically broken and the impression and blanket cylinders are automatically moved out of co-operation. The tripping of the applicator roller and cylinders and the reduction in fluid transfer are selected to take place at a time such that any material still in train in the machine is properly coated. When the flow of material through the machine is recommenced, material is again detected at said location and at a time interval

(selectable by the operator) after this a trip-on sequence is initiated wherein the applicator roller automatically trips to its position where it contacts the fluid receiving surface the amount of fluid being transferred is adjusted and contact is re-established between the blanket and plate cylinders, so as to re-establish the thickness of the film of coating fluid. Then, when the first material reaches the coating station, the blanket cylinder moves into co-operation with the impression cylinder so as to apply coating fluid to the first and subsequent material.

In some circumstances when operating as a coating machine, it may be found that there is an excessive accumulation of fluid on the applicator roller when it is in its position where it is spaced from the fluid receiving surface. This can be avoided by arranging for the mechanism to operate in a third mode (also selectable by the selector switch) which is similar to the second mode but in which, additionally, the means of transferring fluid from the source to the applicator roller is rendered ineffective. In the case where the means of transferring the fluid includes three rollers capable of adopting, with the applicator roller, the first, second, third and fourth configurations as previously described, this can be achieved by arranging for the applicator roller to be capable of occupying two positions in which it is spaced from the fluid receiving surface. In one of these the applicator roller maintains contact with the second roller and the third roller contacts the second and fourth rollers i.e. the rollers adopt the aforementioned second configuration; in the other, the applicator roller is spaced from the second roller and the third roller is spaced from the second roller but maintains contact with the fourth roller i.e. the rollers adopt the aforementioned third configuration. When operating in the third mode the mechanism, in dependence upon the detecting means, causes the rollers to adopt the second configuration and the amount of fluid transferred to the applicator roller to be adjusted at a selectable time interval before no further material is present at said station. Thereafter the rollers are caused to adopt the third configuration wherein flow of fluid from the source to the applicator roller is prevented at a selectable time interval before no further material is present at said station. Then, at a selectable time interval before further material is present at said station, the rollers are caused to return to the second configuration (where flow of fluid from the source to the applicator roller is restored). Thereafter, at a selectable time interval before further material is present at said station, the rollers are caused to adopt the first configuration and the amount of fluid transferred to the applicator roller is adjusted.

In operation, the selector switch is actuated by the operator so that the mechanism operates in the third mode. In this way, at a time interval (selectable by the operator) after no material is detected at said location the mechanism initiates a trip-off sequence wherein the applicator roller automatically moves from its first position to its third position in which it is spaced from the fluid receiving surface and from the second roller, and the third roller automatically moves from its first to its second position, (i.e. the rollers adopt the third configuration) and the amount of fluid transferred to the third roller is adjusted, until such time as the flow of material recommences. When the last material in train in the machine has passed the coating station, the contact between the blanket and plate cylinders is automatically broken and the impression and blanket cylinders are automatically moved out of co-operation. When the flow of material through the machine is recommenced, material is again detected at said location and at a time interval (selectable by the operator) after this a trip-on sequence is initiated wherein the third roller returns to its first position, and after a short time interval the applicator roller returns to its second position (i.e. the rollers adopt the second configuration). Then after a further short time interval the applicator roller returns to its first position (i.e. the rollers adopt the first configuration), the amount of fluid being transferred is adjusted, and contact is re-established between blanket and plate cylinders so as to re-establish the thickness of the film of coating fluid. Then, when the first material reaches the coating station, the blanket cylinder moves into co-operation with the impression cylinder so as to apply coating fluid to the first and subequent material.

Preferably, the selector switch is so arranged that when the second or third mode is selected so that the apparatus functions as a coater, the plate inking rollers and any other inking system functions are tripped-off and inhibited from returning to their printing position for as long as the mode is selected.

For a better understanding of the invention and to show how the same may be carried out reference will now be made by way of example to the accompanying drawings, in which:-

Figure 1 is a side elevation of a printing unit of a multi-colour sheet fed offset lithographic printing machine incorporating a fluid application system in accordance with the present invention,

Figure 2 is a plan view of the system of Figure 1,

Figure 3 is a diagrammatic side view of the system of Figure 1 with its rollers in a first configuration,

Figure 4 is a diagrammatic side view of the system of Figure 1 with its rollers in a second configuration,

Figure 5 is a diagrammatic side view of the system of Figure 1 with its rollers in a third configuration,

Figure 6 is a diagrammatic side view of the system of Figure 1 with its rollers in a fourth configuration,

Figure 7 is a side elevation of the lithographic printing machine of Figure 1,

Figure 8 is a side view of a part of the system of Figures 1 to 7 showing mounting details and means of adjusting the rollers and of moving them between their respective positions,

Figure 9 is a diagram showing an electrical circuit for the control of the roller positions of the system of Figures 1 to 8,

Figure 10 is a view similar to that of Figure 2 but illustrating another embodiment of the invention, and

Figure 11 is a view similar to that of Figure 2 but illustrating a further embodiment of the invention.

Referring to the drawings, and particularly to Figures 1 and 2, there is shown a fluid applying

system suitable for the application of damping solution during lithographic printing or for the application of coating fluid during coating.

The system includes plate cylinder 1 carrying a printing plate having a cylindrical surface for receiving fluid (e.g. damping solution or coating solution or emulsion) from a souce of fluid in the form of a trough 2 and a conventional means (not shown) is provided to rotate the cylinder. The fluid is circulated through the trough *via* a pump and a conventional filter (not shown) so as to maintain a constant level in the trough by means of a conventional weir or the like (not shown). The fluid is applied to the cylindrical surface of the plate by means of an applicator roller 3 mounted for rotation in contact with the plate. Fluid is transferred to the applicator roller 3 from the trough by means of a second roller 4 mounted for rotation in contact with the applicator roller 3, a metering roller 5 mounted for rotation in contact with the second roller 4 and a fourth roller 6 mounted for rotation in contact with the metering roller 5 and immersed in the fluid in the trough. The second roller 4 is equipped with a conventional means (not shown) whereby it can be subjected to axial reciprocation with a stepless variation of the stroke of movement from zero to a maximum. The printing machine includes a blacket cylinder 20 and an impression cylinder 21 in conventional manner.

The cylinder 1 and the rollers 3, 4, 5 and 6 are interconnected by first and second transmission systems comprising trains of gears and idler gears, some fitted with a one-way drive device (e.g. a free wheel clutch) between gear and shaft. The first transmission system comprises a gear 7 fitted on cylinder 1 and having a pitch circle diameter nominally the same as the diameter over the cylinder. This gear 7 engages with an idler gear 8 which in turn engages with a gear 9. Gear 9 is coupled to the shaft of roller 4 by means of a first one-way drive device arranged so that when gear 7 is running in an anti-clockwise direction viewed from left Figure 2 drive is transmitted from the gear to the roller shaft. This permits roller 4 to rotate in an anti-clockwise sense at a higher speed than gear 9 by overruning the first one-way drive device. Hence roller 4 can continue to rotate anti-clockwise when gears 9, 8 and 7 are stationary as, for example, when the machine is stopped and the cylinder 1 is not rotating.

A gear 10 is keyed or otherwise secured to the shaft of roller 4, and engages with a gear 11 which is keyed or otherwise secured to the shaft of roller 3. The gear ratios are selected so that the surface speeds of rollers 3 and 4 when driven by the cylinder 1 *via* the gear train 7, 8, 9, 10 and 11 and the first one-way drive device are the same as the surface speed of the cylinder 1. Thus applicator roller 3 rotates with roller 4.

A variable speed motor 12 is provided to drive roller 6 and a gear 13 is keyed or otherwise secured to the shaft of roller 6 for engagement with a gear 14 keyed or otherwise secured to the shaft of roller 5. (In an alternative embodiment the motor 12 may be arranged to drive roller 5 directly instead).

The second transmission system comprises a further gear 15 secured to the shaft of roller 6. Gear 15 engages with an idler gear 16 which is connected *via* a second one-way drive device to a shaft to which a gear 17 is secured. Gear 17 works in engagement with the gear 10 secured to the roller 4. The second one-way drive device is so arranged that when gear 16 is running in a clockwise direction viewed from the left of Figure 2 drive is transmitted from the gear to the shaft and so to gear 17. Thus gear 17 can rotate in a clockwise sense at a higher speed than gear 16 by overrunning the second one-way drive device and gear 10 (and hence roller 4) can continue to rotate anti clockwise when gears 15 and 16 are stationary or when the pitch line speed of gear 7 running anti clockwise is greater than the pitch line speed of gear 15 running anti clockwise. (In an alternative embodiment, the gear 16 can engage with gear 13 to provide a drive to roller 4. Alternative methods of enabling roller 4 to be continually rotating even when cylinder 1 is stationary involve using a completely independent motorised drive for roller 4 or a gearless drive from roller 6).

It will be apparent that when operating there is usually relative motion at the nip between rollers 4 and 5 with roller 4 being driven by the cylinder 1 at relatively high speed and roller 5 being driven by roller 6 and its variable speed motor 12 at relatively low speed. Control of the amount of fluid fed up to the applicator roller 3 (and hence to cylinder 1) is effected by controlling the speed of rotation of roller 6 through the variable speed control provided for the drive motor 12 and by adjusting the nip pressures between the contacting rollers.

As will be described hereinafter, the mountings for all four rollers 3, 4, 5 and 6 incorporate conventional means to adjust the distances between the roller centres at each end so that the rollers can be set mutually parallel and the pressures between rollers can be adjusted. The mountings for roller 6 in particular are so arranged that roller 6 can be set skewed relative to roller 5 so that the distance between the centres of the rollers at each end is different to the distance between the centres at the middle of the rollers. This permits an increased feed of fluid into the roller system at the extremities of the roller relative to the feed at its centre.

In addition, the mounting of applicator roller 3 is arranged so that it can be tripped from a first position in which it contacts the plate to a second position in which it is spaced from the plate but still contacts second roller 4. A second trip movement causes roller 3 to adopt a third position in which it remains out of contact with the plate but is also out of contact with roller 4. A third trip movement causes roller 3 to adopt a fourth position in which it remains out of contact with roller 4 but moves back into contact with the plate 1 so that roller 3 can be cleaned *via* the plate through the printing press inking system cleaning equipment, when the system is used in conjunction with a lithographic printing press plate cylinder.

The mounting of roller 5 is additionally arranged so that roller 5 can be tripped between a first position in which it contacts the second roller 4 and the fourth roller 6 and a second position in which it is spaced from roller 4 but still contacts roller 6.

When the machine is running normally with sheets passing through and the fluid film being applied, the rollers are in a first configuration as shown in Figure 3. Roller 4 is driven by gears 7, 8 and 9 *via* the first one-way drive device and drives roller 3 *via* gears 10 and 11. Roller 6 is driven at relatively low speed by its variable speed electric motor 12 and roller 5 is driven at a corresponding speed by gears 13 and 14. Gear 17 is driven in a clockwise sense at relatively high speed by gear 10, and the second one-way clutch slips to allow gear 16 to run at relatively low speed as driven by gear 15.

Control of the amount of fluid applied is effected by varying the speed of the electric motor 12 driving roller 6. It is an advantage if the motor speed control is electronic, so that it can readily be coupled to equipment designed to control the supply of fluid automatically. A further control of the amount of fluid applied can be effected by adjustment of the pressure between rollers 4 and 5 or between rollers 5 and 6 at their contact zones, and an adjustment to the supply to the ends of the rollers relative to their centre sections (and thus to the edges of the printing plate mounted on cylinder 1 during printing) can be arranged by skewing roller 6 so that its ends are somewhat further separated from roller 5 than its centre. Thus the supply at the ends of the rollers is more than the supply at the centre, and for a given rate of feed the supply at the ends is increased. If the rate of feed is reduced, the supply at the ends can be maintained while the supply at the centre is reduced. Intermediate settings are obviously possible.

Additional local control may be effected by scrapers bearing on roller 6 or roller 4 to remove fluid before it reaches roller 3, or "squeegee" rollers bearing on roller 6 or roller 4 for the same purpose. This, especially when coupled with a reduction in the axial movement of roller 4 reduces the supply of fluid to areas not requiring it, and thereby prevents undue accumulation of fluid in these zones of the fluid application system. This is particularly useful when printing or coating material of a size less than the maximum width capacity of the machine system. In order to minimise any risk of damage to soft roller surfaces when scraper blades or squeegee rollers are in use and the fluid film thickness is locally reduced, it may be desirable to apply a lubricant fluid (with properties compatible with the fluid being applied) to the roller system after the position of the scraper blades or squeegee rollers. The lubricant fluid may be applied in the form of a mist or spray from a suitable means of providing a small regulated supply.

Should the regular flow of material to be printed or coated be halted, the supply of fluid to the cylinder 1 must be controlled to prevent accumulation. In certain cases, as for example when the fluid application system is operating in a mode in which it serves as a damping system, it is desirable that roller 3 should remain in contact with the printing plate on cylinder 1 to keep it moist, but that the amount of fluid supplied to it should be greatly reduced. In order to achieve this an automatic control can be brought into operation so that the speed of roller 6 is reduced to a relatively low speed, while the rollers remain in the position shown in Figure 3.

Interruption of the supply of fluid can be effected if necessary by tripping roller 3 about the centre of roller 4 to a second position in which it is out of contact with the plate as shown in Figure 4. When the roller system is in this second configuration, during normal operating procedures, the printing machine may be stopped by the operator, it it may be turned at various speeds. It is desirable that under these conditions all the rollers in the fluid application system should remain in contact and continue to rotate constantly so as to prevent drying out and the subsequent waste of time involved in re-establishing their most conditions or even washing if the fluid has dried out and left a deposit on the roller surfaces. If, when in the configuration shown in Figure 4, the machine is running at such a speed that the speed of gear 17 driven by gears 7, 8, 9 and 10 exceeds the speed of gear 16 driven by gear 15, then the second one-way drive device will slip and rollers 4 and 3 will be driven from the cylinder 1 *via* gears 7, 8, 9, 10 and 11 and the first one-way drive device. If the cylinder 1 is stopped gears 7, 8 and 9 become stationary, and rollers 4 and 3 are driven by gears 15, 16, 17, 10 and 11 *via* the second one-way drive device and the first one-way drive device will slip. In either set of circumstances, roller 5 is driven from roller 6 by gears 13 and 14. Thus, the rollers 3, 4, 5 and 6 are kept in mutual contact and the fluid lifted by roller 6 from the trough is circulated to keep the system moist.

Whenever the plate cylinder is stopped, the applicator roller 3 is automatically lifted off the plate cylinder so that it adopts its second position as shown in Figure 4.

When the system is being used to apply a damper fountain solution to a lithographic plate, the surface of roller 3 can become contaminated to a degree by ink picked up from the image areas of the printing plate. When the press is in the configuration shown in Figure 4, under certain circumstances, (depending on the degree of contamination of the surface of roller 3, the type of ink and fountain solution composition, and the degree of cleanliness of the system as a whole which slowly deteriorates during a printing run) ink from roller 3 can transfer to roller 4. This has the effect of reducing the efficiency of the surface of roller 4 for carrying the uniform film of fountain solution desirable for lithographic printing. Ink can be fed back furthermore to rollers 5 and 6, and affect their efficiency in the same way. In order to isolate roller 3 completely if desired, a second tripping action is provided so that the rollers take up a third configuration as shown in Figure 5, in which roller 3 moves to a third position where it is spaced from roller 4 while remaining out of contact with the printing plate and roller 5 moves to a second position where it is out of contact with roller 4 while remaining in contact with roller 6. The roller 3 moves through a small distance only which is insufficient to cause complete disengagement of the drive gears 10 and 11. When it is anticipated that the rollers will be stopped it is desirable that rollers 4 and 5 are separated to avoid the formation of a semi-permanent impression in the resilient surface of

roller 5 as a result of its contact with roller 4. When long machine stops are anticipated roller 5 may also be separated from roller 6.

A fourth roller configuration as shown in Figure 6 is employed when the roller system is used to apply fountain solution for lithographic printing. In this configuration, roller 3 moves to its fourth position where it contacts the printing plate on cylinder 1 while remaining isolated from roller 4 and the roller system. This is used as an aid to speedy washing of the surface of roller 3. At the end of a print run, or at other times as may be necessary, a solvent is applied to the rollers of the press inking system which reduces the ink on the rollers and the ink-containing solvent is then continuously removed during the "wash up" operation by a resilient squeegee blade applied to one of the inking system rollers. After the inking system has been cleaned in this way, a second cleaning operation can be carried out while the plate inking rollers are in contact with the printing plate and roller 3 of the damping system is also in contact with the printing plate, so that accumulations of ink on the surface of roller 3 are taken up by solvent and ultimately removed *via* the printing plate, inking rollers, and squeegee blade. This effects a significant reduction in cleaning time. It will be noted that roller 3 can move from the position shown in Figure 5 to the position shown in Figure 6 without contacting roller 4.

Referring now to Figure 7, there is shown a lithographic printing machine comprising 6 units denoted by reference numerals 22, 23, 24, 25, 26 and 27 and a means of transporting sheet material along a path (represented by the solid line 28) through the machine from a feeding station 29 to a delivery station 30. As the sheet material moves along the path it passes through the fluid applying station associated with each unit. Basically the six units are identical to that shown in Figure 1 except that units 22 to 26 are ordinarily intended for printing only whereas the final unit 27 is intended for printing or coating. The machine includes a detector arranged to detect the presence of sheet material at a location along the path 28, for example at the feeding station 29. The detector 29a may, for example, be in the form of a photocell or a proximity sensor as known in the art and is operably connected by means of a selector switch with a mechanism (more particularly described hereinafter) associated with the final unit 27 and capable of operating in first, second or third modes depending upon the setting of the selector switch.

When the passage through the machine of the sheet material to be printed or coated is initiated, or resumed after an interruption, it is desirable that the roller systems and the printing plates of the units are refreshed with the respective fluid before the material arrives at the stations where it is printed or coated.

When the roller system of unit 27 is to be used in a printing mode in which it serves to apply a damper fountain solution to a lithographic plate, the operator can by suitably activating the selector switch cause the mechanism to operate automatically in the first mode. In this mode, when the detector signals that sheets are flowing satisfactorily, the mechanism brings the applicator roller 3 of unit 27 into contact with the printing plate (if they have been separated) a pre-set number of machine revolutions before the material reaches the printing station and the speed of roller 6 of unit 27 is increased when the material reaches the printing station of unit 27. When the supply of material through the machine is interrupted, a signal from the detector is given, and as the last of any material in train has passed the printing station of unit 27 the speed of the drive to roller 6 of unit 27 is reduced to reduce the amount of damper solution being transferred to the applicator roller 3 of unit 27. The roller system is thus in the first configuration shown in Figure 3 with the applicator roller 3 remaining in contact with the printing plate on cylinder 1 to keep it moist. If the interruption of the supply of material is protracted, the roller 3 may be tripped into its second position as shown in Figure 4 in which it continues to be rotated as previously described. Units 22 to 26 operate in an identical manner.

When the roller system of unit 27 is to be used for coating in which it serves to apply a coating medium to sheet material already printed by units 22 to 26, it is desirable that the film of the medium on the roller and cylinder surfaces is renewed and refreshed by the time a newly started flow of sheet material reaches the coating station of unit 27. Similarly, it is desirable that when the flow of material is interrupted the film of coating medium remaining on these surfaces is reduced to a minimum consistent with satisfactory working. This is effected by the operator actuating the selector switch so that the mechanism operates automatically in a second mode. In this second mode when the machine detector signals that sheets are flowing satisfactorily, the following events occur at a number of revolutions of the machine (selected by the operator according to the work in hand) before the material reaches the coating station of unit 27; the applicator roller 3 of unit 27 is brought into contact with the plate on cylinder 1; the speed of the drive to roller 6 of unit 27 is increased to a pre-selected speed; and the printing press blanket cylinder 20 of unit 27 is brought into contact with the plate cylinder 1 of unit 27. Then, when the first material reaches the coating station of unit 27, the blanket cylinder 20 is brought into contact with the material as it passes over the press impression cylinder 21. When the supply of material through the machine is interrupted, a signal from the detector at the feeding station is given, and at a pre-selected number of revolutions of the machine (not necessarily the same number as that selected for the initiation sequence) selected by the operator according to the work in hand before the last material reaches the coating station the applicator roller of unit 27 is moved out of contact with the plate on cylinder 1 and the speed of the drive to roller 6 of unit 27 is reduced. When the last material has passed the coating station, the blanket cylinder 20 moves out of co-operation with the impression cylinder 21 and the contact between blanket cylinder 20 and plate cylinder 1 is broken. The roller system is now in the configuration shown in Figure 4 and

continues to rotate with all constituent rollers kept in a moist condition.

Alternatively when coating the operator may have actuated the selector switch so that the mechanism operates in a third mode. In this case, a course of events similar to that of the second mode takes place except that, when tripping on, the third roller 5 and the applicator roller 3 of unit 27 (which have been separated from roller 4 under the influence of the mechanism operating in the third mode) are brought into contact with roller 4 before applicator roller 3 contacts the plate of plate cylinder 1 and, when tripping off, the applicator roller 3 and third roller 5 separate from roller 4 so that the rollers adopt the third configuration as shown in Figure 5.

It will be apparent that roller 3 of each unit is driven at all times (except when power is off) during normal operations, irrrespective of machine speed or trip position so as to keep its surface moist to prevent drying out of any ink deposited on it during use as a damping system. If the roller system has been moved into the configuration shown in Figure 5, it is advantageous to return it to the configuration shown in Figure 4 before resuming the flow of material so that the film of fluid on the rollers can be renewed and refreshed.

The film of coating fluid can be relatively thick, whereas fountain solution requirements are normally for relatively thin films. In order to assist rollers 4 and 6 of unit 27 to carry heavy films their surfaces can be engraved with a regular pattern of cells or identations into the surface to provide a greater fluid carrying capacity. Such rollers are generally known in the trade as Anilox rollers, and the pattern and capacity of the engraved cells can be varied to suit different specific requirements. Various other finishes can be employed to assist rollers 4 and 6 to carry fluid such as chrome plating, etching, and micro-cracked chrome depending upon the nature of the fluid.

To improve the uniform distribution of the fluid being applied, each unit may include an additional oleophilic rider roller which runs freely in contact with roller 3 and, by attracting any ink adhering to the surface of roller 3 to its own surface, assists in keeping the surface of roller 3 clean and able to maintain an even film of damping solution. In the case where the unit 27 is operating in the coating mode, this additional rider roller assists roller 3, by the reservoir effect of the fluid film carried on the surface of the additional roller, to present a uniform film to the surface on cylinder 1. The additional rollers may be gear driven from rollers 3 and preferably, though not essentially, are provided with means for axial reciprocation.

The surfaces of rollers 4 and 6 (and of the additional rider rollers if fitted) are relatively hard, while the surfaces of rollers 3 and 5 are relatively soft, a prerequisite of all these surfaces being that they will be wetted by the fluids they apply, including lithographic fountain solutions, solidus fluids for curing by exposure to ultra-violet radiation, emulsions, spirit based lacquers, and varnishes. Special surfaces may be provided for rollers 3 and 5 to assist them to carry the fluid being applied, and to resist attack by chemical agents contained in the fluid or contained in fluids or materials used to clean the system.

The drive between rollers 5 and 4 of each unit may be either by friction or by geared or other connection, with a provision for the surface speed of roller 4 to be faster than that of roller 5 when in operation. The gear ratio between roller 5 and 6 may also be selected so that there is a small difference in surface speed of these rollers to assist self cleaning.

Referring now to Figure 8, this is a view of one side of the means provided for the support, adjustment and movement of the rollers, and for illustrative purposes they are shown in the same configuration as in Figure 3, that is to say in their normal operative position applying fluid to the surface of the plate on cylinder 1.

Roller 6 is rotatably mounted in bearings carried by a member 59 secured to the printing machine frames, which also serves to carry the trough 2. Roller 4 is rotatably mounted in bearings carried in a further member not shown. The centres of rotation of rollers 6 and 4 are fixed relative to the machine frames.

A bracket 60 is carried on a bush about the centre of roller 6, so that it can swing about that centre. It is restrained by spring 61 bearing against stud 62 and bracket 63 secured to the printing machine frames. Passing through the spring 61 is a screw 64 which has a screw threaded portion engaging with a thread in stud 62, and a shoulder which abuts on bracket 63 under the pressure of spring 61. Roller 5 is carried in a bearing cup with a spigot 65 passing through bracket 60 and mounted into bracket 60 by means of an eccentric bush 66. This eccentric bush is provided with a wormwheel engaging with a worm carried on bearings fixed to bracket 60 and connected to shaft 68. An adjustment of roller 5 towards or way from roller 4 is effected by turning screw 64 with a knob provided for that purpose. The small rotational movement of bracket 60 is about the centre of roller 6 and thus no disturbance to the adjustment of roller 5 to roller 6 takes places. Adjustment of roller 5 towards or away from roller 6 is affected by turning worm 67 by means of shaft 68 and a knob provided on the shaft, thereby turning the eccentric bush 66, which is arranged so that within the relatively restricted range of adjustment normally required no significant disturbance to the adjustment of roller 5 to roller 4 takes place as eccentric 66 turns.

Roller 3 is carried in a bearing cup with a spigot 69 passing through a bracket 70 and mounted into bracket 70 by means of an eccentric bush 71. This eccentric bush is provided with a wormwheel engaging with a worm 72 carried on bearings fixed to bracket 70 and connected to shaft 73.

A spigot fixed to the machine frame has a diameter 74 concentric with the fixed axis of roller 4, and is bored through to permit the spindle of roller 4 to pass into suitable bearings. The spigot carries a lever 75 rotatably mounted on the diameter 74. Projecting from this lever is a spigot 76 whose diameter is eccentric to the diameter 74, and bracket 70 is rotatably mounted on spigot 76.

A further lever 77 is rotatably mounted on a fixed

shaft 78, and is restrained by a rectangular block 79 engaging in a slideway 80 machined in lever 77. This block is supported by a shaft 81 rotatably mounted in the machine frames, and the shaft 81 engages with the block 79 by means of a section machined with diameter 82 eccentric to the diameter forming the bearing portion of shaft 81.

Lever 77 carries a link 83 which is attached to the lever by means of a stud 84. This stud can rotate in lever 77 and in link 83 and its diameters engaging respectively with lever and link are eccentric one to the other. The stud 84 is provided with a wormwheel engaging with a worm 85 carried on bearings fixed to lever 77 and connected to shaft 86. The end of link 83 remote from lever 77 is attached to bracket 70 by engaging with an extension of the outside diameter of bush 71, that is the diameter of this bush eccentric to the centre of roller 3.

It will be seen that the bracket 70 carrying the bearing cup supporting roller 3 is held in position by means of levers 75 and 77 and link 83. An adjustment of roller 3 towards or away from the plate cylinder 1 is effected by turning worm 85 by means of shaft 86 and a knob provided on the shaft, thereby rotating eccentric stud 84 and *via* link 83 rotating bracket 70 about its mounting on lever 75 and hence moving roller 3 carried from bracket 70 relative to place cylinder 1 whilst leaving its setting relative to roller 4 substantially unaltered. An adjustment of roller 3 relative to roller 4 is effected by turning worm 72 by means of shaft 73 and a knob provided, thereby turning eccentric bush 71 so that the bearing cup carrying roller 3 is moved relative to roller 4 without significantly altering its position relative to surface 1.

Now shaft 81 is secured to a gear 87 in engagement with gear teeth cut in a quadrant forming an integral part of a lever 88 rotatably mounted in the machine frames. A boss 89 on an extension of lever 88 is connected to a double acting first hydraulic cylinder 201 (partially shown only in chain-dotted lines) in such a way that actuation of the first hydraulic cylinder can move boss 89 between positions 89 and 90. If the hydraulic cylinder 201 is actuated so as to move boss 89 to position 90, gear 87 is rotated one half turn and shaft 81 with its eccentric portion 82 also rotates so that the block 79 is lifted and lever 77 is turned anti-clockwise. Link 83 is moved to the right so that bracket 70 is moved clockwise carrying roller 3 out of engagement with the surface of the plate on cylinder 1. Since bracket 70 is mounted about roller 4, the contact between rollers 3 and 4 remain relatively undisturbed, and the rollers now lie in their second configuration shown in Figure 4. The rollers may be returned to their operative configuration shown in Figure 3 by actuating the first hydraulic cylinder 201 in the opposite sense so as to return boss 89 from position 90 to position 89, upon which the motions just described are reversed.

Lever 75 is also provided with an extension with a boss 91 connected to a second double acting hydraulic cylinder 202 (shown partially only in chain-dotted lines) in such a way that actuation of the second hydraulic cylinder can move boss 91 between positions 91 and 92. Another extension of lever 75 carries a runner 93. As lever 75 is rotated clockwise this runner first approaches and then contacts a face 94 on bracket 60, and then further clockwise movement of lever 75 causes bracket 60 to rotate clockwise. Rotation of lever 75 and hence eccentric diameter 76 lifts bracket 70 relative to the axis of roller 4, thereby breaking the contact between roller 3 and roller 4. The continued movement of lever 75 causes bracket 60 to rotate and contact between rollers 4 and 5 is broken.

When boss 89 has been moved to position 90 and boss 91 has been moved to position 92, the rollers are in their third configuration shown in Figure 5. Clearly rollers 3 and 5 can be returned to their first positions by moving boss 91 from position 92 to position 91 upon which the motions described above are reversed.

Levers 75 and 88 are operated independently, and when boss 91 on lever 75 is lying in position 92, so that the contacts between rollers 3 and 4 and between rollers 4 and 5 are borken, lever 88 can be returned by actuating the first hydraulic cylinder 201 so as to move boss 89 from position 90 to position 89. In the manner described, this causes roller 3 to return to contact the surface of the plate on cylinder 1 while other roller contacts controlled by lever 75 remain broken. The rollers are now in their fourth configuration as shown in Figure 6.

It is particularly advantageous that roller 4 is pre-wetted by roller 5 before contact is restored between roller 4 and roller 3. The second hydraulic cylinder 202 is supplied with its working fluid *via* a restrictor which restricts the rate of flow of working fluid and hence the speed of operation of the hydraulic cylinder. Lever 75 is therefore moved *via* boss 91 at a slow speed, so that when the boss is moving from position 92 to position 91 the runner 93 first allows face 94 and therefore bracket 60 to return and restore contact between roller 5 and roller 4, and then only after a delay as the remaining movement of lever 75 is completed is the contact between roller 3 and roller 4 restored. This "lost motion" between runner 93 and face 94 and the low speed working of the second hydraulic cylinder 202 constitutes a time delay mechanism.

The hydraulic cylinders are controlled by solenoid operated valves of conventional design. Each valve is controlled by electrical signals either from a circuit designed to trip the rollers and other printing machine functions automatically in accordance with the presence or absence of material, of for manual operation to allow the operator to override the automatic functions.

The flow of working fluid in each hydraulic cylinder is controlled by a conventional spool valve which may be moved between two working positions by energising one or another of two solenoids. When one solenoid is energised, the spool valve moves to a first position and fluid flow in the hyraulic cylinder takes place so that its connecting rod coupling its piston to its associated lever moves to a first extreme position. It will remain in this position even if the solenoid is no longer connected to an electrical supply until the other solenoid is energised. The spool valve is thus moved to its second

position and the hydraulic cylinder piston moves to its original extreme position and the lever is moved accordingly. Again, even if the electrical supply to the solenoid is disconnected the spool valve and thus the hydraulic cylinder piston remains in position.

Figure 9 is a schematic electrical diagram showing how selector switches and relays may be employed to control the hydraulic cylinders used to move rollers of the printing machine into and out of engagement. Electrical power from a single phase supply is connected across supply wires 95 and 96. The contacts of all switching members are shown in Figure 9 in the positions they would take up after all printing functions had moved out of engagement and the main power supply had been switched off.

When the press oeprator first commences operations he will connect the main power supply, and will switch on the printing unit trip functions, so that contact 97 opens, contact 98 changes over and contact 99 closes. He will also select the mode of operation of the circuit *via* switch 100; in position 101 the circuit operates in a first mode for printing, in position 102 the circuit operates in a second mode for coating and in position 103 the circuit operates in a third mode for coating.

Operation in the first mode as material begins to flow through the printing machine is as follows. Selector switch 100 is connected to position 101. When material is presented to the printing machine the detector 29a at the feed station 29 senses its presence and a relay coil (not shown) is energised, causing contact 104 to change position. Power is supplied to a counter 105 *via* a cam operated switch 106 arranged to close once per machine revolution. Each pulse *via* switch 106 counts one revolution. Now in the case illustrated in Figure 7, the machine must make 21 revolutions from the time material is first sensed at the detector to the time it arrives at unit 27. If, for example, the operator requires certain functions to move into their print position ten revolutions before the first material reaches unit 27, he sets the counter 109 so that it counts eleven and then closes contact 107. Provided that the main drive motor is running "forwards" so that a contact 108 is closed, power is supplied to relay coils 109 and 110. Relay 109 has a contact 111 which closes when its coil is energised, and a supply is connected to solenoid 112 which operates a spool valve so that the second hydraulic cylinder 202 moves lever 75 and roller 5 is brought into contact with roller 4 if they have been separated and roller 3 is brought into contact with roller 4. Relay 110 is a delay relay, and its contact 113 closes a few seconds after the coil is energised, and relay coil 114 is energised. Relay 114 has a contact 115 which closes when its coil is energised and a supply is connected to solenoid 116 which operates a spool valve so that the first hydraulic cylinder 201 moves lever 88 and roller 3 is brought into contact with surface 1, all before material has reached the station. When relay coil 114 is energised a further contact 117 changes position, but does not change the state of the part of the circuit into which it is incorporated.

As the material reaches the printing station its presence is detected by a switch 118 which is built into a transfer cylinder gripper and closed by the physical presence of material in the gripper. Other methods of detection such as photocells and proximity sensors are commonly used for this purpose. A switch 119 is arranged to close for a short time during the part of the printing machine cycle in which material, if present, would close switch 118. When both switches 118 and 119 are closed together, power is supplied to relay coil 120. This relay has a contact 121 which closes when the coil is energised, and this contact is in series with a switch 122 which is closed during the part of the machine cycle in which the switch 119 is open. It will be seen that when this switch 119 subsequently opens, the power supply to relay coil 120 is sustained *via* switch 122 and contact 121.

A further contact 123 of relay 120 changes position when the coil is energised, and provided switch 124 is set to the position shown in Figure 9, that is for automatic operation, when a cam operated switch 125 is closed during the next revolution of the printing machine power is fed to solenoid 126 *via* switches 124, 125, 117, 127 and 123. Solenoid 126 operates a spool valve controlling a hydraulic cylinder arranged to turn an eccentric bearing housing (not shown) in well known conventional manner so that the plate cylinder is moved into contact with the blanket cylinder. A further contact 128 of relay 120 closes when the relay is energised so that power is supplied *via* a relay contact 129 and contact 128 to relay coil 130, whose contact 131 changes position so that resistor 133 is connected into fountain roller 6 drive motor 12 speed controller circuit 134 effecting a change in the motor speed, provided switch 135 is closed - this switch being for the purpose of switching off the power to the motor if required.

A further contact 136 of relay 120 changes position when the coil is energised, and *via* selector switch 137, cam operated switch 138, and contact 136 solenoid 139 is energised working a spool valve and hydraulic cylinder so as to bring the blanket cylinder 20 into engagement with impression cylinder 21.

A further contact 140 of relay 120 changes position when the coil is energised, and *via* contact 141, selector switch 142, cam operated switch 143 and contact 140 solenoid 144 is energised working a spool valve and hydraulic cylinder so as to bring the inking rollers (not shown) into contact with the printing plate and start the ink feed.

The circuit remains in the state now reached until the detector at feeding station 29 senses that the flow of material has been interrupted. Contact 104 switches and de-energises the coil 105, so that contact 107 of relay 109 opens and de-energises relay coils 109, 110 and 114. Contact 113 of relay 110 opens immediately and re-sets the delay circuit to coil 114. Contact 111 of relay 109 opens, but the hydraulic cylinder controlled by solenoid 112 does not move since its spool valve is bistable. Contact 115 of relay 114 opens, but the hydraulic cylinder controlled by solenoid 116 does not move since its spool valve is bistable. Contact 117 of relay 114 changes position but the hydraulic cylinder controlled by solenoid 126 does not move since its spool

valve is bistable.

No mechanical movement has yet taken place and the sheets already in train are duly printed. When the last sheet has passed the printing station on the next revolution of the printing machine switch 118 will fail to close in the absence of material. When cam operated switch 122 subsequently opens to test the position of switch 118, relay coil 120 is de-energised and its contact 121 opened so that until material is again detected by switch 118 coil 120 remains de-energised.

When coil 120 is de-energised contact 123 changes position and the electrical supply is connected to solenoid 145 *via* selector switch 124 contact 117 and cam operated switch 125 at the proper time to operate the spool valve and actuate the hydraulic cylinder moving the eccentric bearing bush to move the plate cylinder out of contact with the blanket cylinder.

Contact 128 of relay 120 also opens, de-energising relay coil 130 so that its contact 131 changes position so that resistor 132 is connected into the control circuit 134 for fountain roller drive motor 12 so that the speed of the fountain roller 6 is adjusted.

Contact 136 of relay 120 changes position so that solenoid 146 is energised and the blanket cylinder 20 is moved out of engagement with the impression cylinder 21 *via* switches 137 and 138. Contact 140 of relay 120 changes position so that solenoid 147 is energised and the hydraulic cylinder operating the mechanism to lift the inking rollers off the plate and stop the feed of ink is actuated.

The circuit remains now in this state until the flow of material commences again and is detected by the detector at feeding station 29.

When the unit is being used for coating, selector switch 100 is moved to position 102 so that the second mode operates. Relay coil 148 is thereby energised, contact 141 of relay 148 changes position, and a power supply is connected directly to solenoid 147 so that the inking rollers are lifted from the plate and the ink feed stopped - if they are not already in this state - and the supply of power to solenoid 144 is interrupted so long as relay 148 is energised. Thus the inking system is disabled when relay coil 148 is energised for the coater mode of operation.

Contact 127 is a further contact of relay 148, and its position changes when the relay coil is energised.

When the flow of material commences and is detected by the detector at feeding station 29 contact 104 changes its position and the same sequence of switching occurs as has been described, except that now, when relay coil 114 is energised at a time determined by the setting of counter 105 and delay relay 110 and its contact 113, contact 117 of relay 114 when it changes position is enabled *via* contact 127 of relay 148, to supply power to solenoid 126 *via* selector switch 124 and cam operated switch 125, so that as solenoid 126 is energised the plate cylinder is brought into engagement with the blanket cylinder before material has commenced to flow at the coating station.

Furthermore, contact 129 of relay 148 changes position, so that when relay coil 114 is energised a further contact 149 of relay 114 closes, relay coil 130 is energised and contact 131 changes over so that resistor 133 is connected into motor control circuit 134, and the speed of roller 6 is adjusted before material has commenced to flow at the coating station.

When material starts to flow at the coating station, detector switch 118 closes and relay coil 120 is energised so that the blanket cylinder 20 is moved into engagement with the impression cylinder 21 in the manner already described.

When the detector at the feeding station 29 senses that material flow has stopped, contact 104 changes position. Since a contact 150 of relay 148 is closed power can now be supplied to a counter 151 *via* a cam operated switch 152 arranged to close once per machine revolution. After a number of revolutions set by the operator, and if desired less than the number of revolutions taken for the last material to reach the coating station, the contact 153 of counter 151 is closed, and relay coil 154 is energised. A contact 155 of relay 154 closes, and solenoid 156 is energised so that the first hydraulic cylinder 201 is actuated and roller 3 is lifted from the surface 1 before the flow of material ceases at the coating station.

When the flow of material ceases at the coating station detector switch 118 remains open when cam operated switch 122 opens to test its position, relay coil 120 is de-energised, and the plate cylinder is moved out of contact with the blanket cylinder as solenoid 145 is energised *via* switches and contacts 124, 125, 117 and 123 as already described. The blanket cylinder is moved out of contact with the plate cylinder as solenoid 146 is energised *via* switches and contacts 137, 138 and 136 as already described.

If the third mode is to be brought into operation during coating, selector switch 100 is moved to position 103 so that relay coil 157 is energised. A contact 158 of relay 157 is thereby closed and energises relay coil 148 as well. When material is supplied to the printing machine, the various functions move into co-operation one with another in the manner already described with reference to the second mode. When the supply of material is interrupted, the various functions move out of co-operation one with another as previously described for the second mode except that contact 159 of relay 157 is now closed and, when relay coil 109 is de-energised, one of its contacts 160 closes and power is supplied *via* contacts 160 and 159 to solenoid 161 so that the spool valve controlling the second hydraulic cylinder 202 is moved and the cylinder is actuated to move rollers 3 and 5 out of contact with roller 4.

To ensure that roller 3 is out of contact with the plate if the cylinder ceases to rotate or if it should be turned backwards, a contact 162 is provided on the contactor which starts the motor running in a forward direction. If the motor is stopped or runs in reverse this contact will close and supply power to solenoid 156 which moves the spool valve controlling the first hydraulic cylinder 210 and if necessary actuates the cylinder so that contact between roller 3 and the plate 2 is broken. Unless the forward running

contactor is closed one of its contacts 108 remains open and the relay coils 109, 110 and 114 controlling the means used to bring the rollers into contact with each other and the plate are disabled.

Rollers 3, 4, 5 and 6 can be switched manually from the configuration shown in Figure 3 to that shown in Figure 4 by means of push button 163 which energises solenoid 156 actuating the first hydraulic cylinder 201. The rollers can now be switched manually from the configuration shown in Figure 4 to that shown in Figure 5 by operating bush buttom 164 which energises solenoid 161 actuating the second hydrualic cylinder 202. To pass from the configuration shown in Figure 5 to that shown in Figure 6 push button 165 is operated actuating the first hydraulic cylinder in the opposite sense. To return then to the original configuration push button 166 is operated actuating the second hydraulic cylinder in the opposite sense.

It will be apparent that certain additional electrical interlock contacts can be included in the circuit to protect the printing machine and the operator from incorrect operation. Also, whereas the electrical circuit has been described in terms of multiplicity of relays and associated contacts, an electronic logic circuit or programmed logic controller with suitable interfaces could equally serve this purpose.

It will be seen from the above that the embodiment described can be used alternately for the application of either a fountain solution to a lithographic printing plate or a coating fluid of suitable composition. When used only for the application of fountain solution there is usually sufficient frictional drive between rollers 4 and 5 to maintain constant rotation of rollers 4 and 3 when the rollers are tripped to the configuration shown at Figure 4. In this case the gear train 15, 16 and 17 and the second one-way drive device may be omitted in the interests of economy and simplicity.

Although the system has been hereinbefore described in combination with an offset litho press to enable the press to apply either damping solution or a coating medium to the plate cylinder of the press, it is readily adaptable to enable fluid to be applied to, for example, the surface of a cylindrical rubber blanket or transfer roller or indeed directly on to the surface of the material to be coated in a machine constructed primarily for another printing process rather than lithography or in a machine constructed especially for coating or in a part especially constructed for coating of a machine for printing and coating.

Referring now to Figure 10 there is shown an alternative manner of driving the various rollers of the machine. In this Figure, parts corresponding to parts of Figures 1 to 9 are denoted by like reference numerals. In this case, the gear 7 of the plate cylinder 1 (which normally rotates anti-clockwise as viewed from the left) drives a mating inter gear 41 on whose shaft 42 is a second inter gear coupled to the shaft 42 by a one-way drive 43. If the shaft 42 is running clockwise, the second inter gear is driven by this one-way drive 43. A gear 44 on roller 4 engages the second inter gear and also a gear 45 of roller 3. In addition, the gear 44 on roller 4 engages a gear coupled to the shaft 46 of roller 5 *via* a one-way drive 47. If this shaft 46 runs clockwise, drive will be transmitted *via* the one-way drive 47 to the gear 44 on roller 4. Roller 5 is geared to roller 6 and thence to drive motor 12, and runs in a clockwise sense.

Rollers 5 and 6 normally run slowly, driven by motor 12, while rollers 3 and 4 normally run quickly driven by gear 7, in which situation one-way drive 47 slips and there is a slip between the surfaces of rollers 5 and 4. When gear 7 is stationary, running in reverse, or running very slowly, roller 4 is driven by one-way drive 47 and roller 3 is also driven *via* the transmission from motor 12 along with rollers 5 and 6, while one-way drive 43 slips.

Referring to Figure 11 there is shown another alternative manner of driving the various rollers and again parts corresponding to parts of Figures 1 to 9 are denoted by like reference numerals. In this case the gear 7 of the plate cylinder 1 (which normally rotates anti-clockwise as viewed from the left) drives a gear coupled to the shaft 51 of roller 4 by a one-way drive clutch 52 *via* an inter gear 53. If the gear 7 is driven anti-clockwise the clutch 52 transmits motion to the shaft 51 and hence to roller 4. At the other end of roller 4 a gear 54 is provided, meshing with a gear 55 fixed to roller 3 so as to drive roller 3, and also meshing with a gear coupled to the shaft 56 of roller 5 by a one-way drive clutch 57 which is so contructed that if the shaft 56 is driven clockwise motion is transmitted by the clutch 57 to the gear. Another gear 58 is provided on roller 5 meshing with a gear on roller 6 and a gear on drive motor 12. Roller 5 is driven by motor 12 in a clockwise sense.

Rollers 5 and 6 normally run slowly driven by motor 12 while rollers 3 and 4 normally run quickly driven by gear 7 so that there is slip at clutch 57 and between roller surfaces 5 and 4. When gear 7 is stationary, running in reverse, or running very slowly, roller 4 is driven by clutch 57 and roller 3 is driven by roller 4 while clutch 52 slips.

CLAIMS

1. A fluid application system for applying fluid to a moveable fluid receiving surface which system comprises:

(i) an applicator roller moveable between a position in which it contacts said surface and a position in which it is spaced from said surface,

(ii) a source of fluid,

(iii) a means of transferring fluid from said source to said applicator roller,

(iv) a means of rotating the applicator roller at the same surface speed as the surface when it is in its position where it contacts said surface, and

(v) a means of rotating the applicator roller when it is in its position where it is spaced from said surface irrespective of whether or not the surface is moving.

2. A system as claimed in Claim 1 wherein the means of transferring fluid from said source to said applicator roller comprises a rotatably mounted second roller arranged to form a nip with the applicator roller both when it is in contact with the

surface and when it is spaced from the surface and a metering roller mounted for rotation so as to form a nip with said second roller and arranged to receive fluid from said source.

3. A surface as claimed in Claim 2 wherein the second roller and the applicator roller are geared together so that they rotate at the same surface speed and the system includes:-

(i) a first drive means for moving the fluid receiving surface,

(ii) a first transmission system linking the first drive means and the second roller so that the applicator roller can be driven by the first drive means;

(iii) a second drive means for rotating the metering roller independently of the fluid receiving surface, and

(iv) a second transmission system linking the second drive means and the second roller so that the applicator roller can also be driven by the second drive means, the first and second transmission systems being so arranged that

(a) in normal operation of the fluid application system with the applicator roller in its position where it contacts the surface, the applicator roller is driven from the first drive means and the second transmission system is overridden and

(b) when the applicator roller is tripped to its position where it is spaced from the surface and the first drive means is stopped or rotating relatively slowly, the applicator roller is driven from the second drive means and the first transmission system is overridden.

4. A system as claimed in Claim 3 wherein the source is in the form of a trough containing the fluid and the transferring means includes a fourth roller dipping into the fluid in the trough and mounted for rotation so as to form a nip with the metering roller and geared to the metering roller so as to rotate with the metering roller.

5. A system as claimed in Claim 4 wherein the applicator roller, the second roller, the metering roller and the fourth roller can adopt:

(a) a first configuration in which the applicator roller is in a first position in which it contacts said surface and said second roller and the metering roller is in a first position in which it contacts the second roller and the fourth roller,

(b) a second configuration in which the applicator roller is in a second position in which it is spaced from said surface but contacts said second roller and said metering roller is in its first position,

(c) a third configuration in which the applicator roller is in a third position in which it is spaced from said surface and from said second roller and said metering roller is in a second position in which it is spaced from the second roller but contacts the fourth roller, and

(d) a fourth configuration in which the applicator roller is in a fourth position in which it contacts said surface but is spaced from said second roller and said metering roller is in its second position.

6. A fluid applying machine for applying fluid to material which machine comprises,

(i) a moveable fluid-receiving surface,

(ii) a fluid application system as claimed in any one of Claims 1 to 5,

(iii) a means for controlling the amount of fluid transferred from said source of fluid to said applicator roller,

(iv)a means of transporting material though the machine along a path to a station at which it can receive fluid from said fluid receiving surface,

(v) a means of detecting the presence or absence of material at a location along said path,

(vi) a mechanism actuable in dependence upon the detecting means and operable in

(a) a first mode in which it regulates the fluid controlling means such that the amount of fluid transferred to said applicator roller is adjusted in dependence upon whether or not material is present at said station, and

(b) a second mode in which it moves the applicator roller between its positions and regulates the fluid controlling means such that the applicator roller is moved to its position in which it is spaced from said surface and the amount of fluid transferred to it is adjusted at a selectable time interval before no further material is present at said station and the applicator roller is moved to its position in which it contacts said surface and the amount of fluid transferred to it is adjusted at a selectable time interval before further material is present at said station, and

(vii) a selector switch operably connected to said detecting means for enabling the mechanism to operate in either the first mode or the second mode as desired.

7. A fluid applying machine as claimed in Claim 6 wherein the mechanism is operable in a third mode in which, in addition to carrying out the functions required by the second mode, it renders ineffective the means of transferring fluid from the source to the applicator roller, said selector switch enabling the mechanism to operate in the third mode as desired.

8. A fluid applying machine as claimed in Claim 7 when appendant to Claim 5 wherein, when the third mode is selected, the mechanism causes the rollers to move between the second configuration and the third configuration in dependence upon the detecting means such that the rollers adopt the third configuration at a selectable time interval before no further material is present at said station and the rollers return to the second configuration at a selectable time interval before further material is present at said station.

9. A fluid application system as claimed in Claim 1 substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 6 of the accompanying drawings.

10. A fluid application system as claimed in Claim 1 substantially as hereinbefore described with reference to and as illustrated in Figures 10 and 11 of the accompanying drawings.

11. A fluid applying machine as claimed in Claim 6 substantially as hereinbefore described with reference to and as illustrated in Figure 7 of the accompanying drawings.

12. A fluid application system for applying fluid to a moveable fluid-receiving surface, which system

comprises,

(i) an applicator roller,

(ii) a source of fluid, and

(iii) a means of transferring fluid from said source to said applicator roller, which transferring means comprises second, third and fourth rollers, wherein said rollers can adopt

(a) a first configuration in which the applicator roller is in a first position in which it contacts said surface and said second roller and the third roller is in a first position in which it contacts the second roller and the fourth roller,

(b) a second configuration in which the applicator roller is in a second position in which it is spaced from said surface but contacts said second roller and said third roller is in its first position,

(c) a third configuration in which the applicator roller is in a third position in which it is spaced from said surface and from said second roller and said third roller is in a second position in which it is spaced from the second roller but contacts the fourth roller, and

(d) a fourth configuration in which the applicator roller is in a fourth position in which it contacts said surface but is spaced from said second roller and said third roller is in its second position.

13. A fluid applying machine for applying fluid to material which machine comprises,

(i) a moveable fluid-receiving surface,

(ii) a fluid application system comprising an applicator roller, a source of fluid, and a means of transferring fluid from said source to said applicator roller, said applicator roller being moveable between a position in which it contacts said surface and a position in which it is spaced from said surface,

(iii) a means for controlling the amount of fluid transferred from said source of fluid to said applicator roller,

(iv) a means of transporting material through the machine along a path to a station at which it can receive fluid from said fluid receiving surface,

(v) a means of detecting the presence or absence of material at a location along said path,

(vi) a mechanism actuable in dependence upon the detecting means and operable in

(a) a first mode in which it regulates the fluid controlling means such that the amount of fluid transferred to said applicator roller is adjusted in dependence upon whether or not material is present at said station, and

(b) a second mode in which it moves the applicator roller between its positions and regulates the fluid controlling means such that the applicator roller is moved to its position in which it is spaced from said surface and the amount of fluid transferred to it is adjusted at a selectable time interval before no further material is present at said station and the applicator roller is moved to its position in which it contacts said surface and the amount of fluid transferred to it is adjusted at a selectable time interval before further material is present at said station, and

(vii) a selector switch operably connected to said detecting means for enabling the mechanism to operate in either the first mode or the second mode as desired.

14. A fluid applying machine as claimed in Claim 13 wherein the mechanism is operable in a third mode in which, in addition to carrying out the functions required by the second mode, it renders ineffective the means of transferring fluid from the source to the applicator roller, said selector switch enabling the mechanism to operate in the third mode as desired.

15. A fluid applying machine as claimed in Claim 6 substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 9 of the accompanying drawings.

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